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AUTHOR Kuntz, Steven S.
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ABSTRACT

The way that students structure the colleges they choose among in a particular educational market is analyzed with a sample of 408 locally-college-bound high school seniors from 16 area schools. In January and February 1985, the College Image Questionnaire was administered to the seniors. The students judged the similarity (psychological distance) between nine pairs of colleges that preliminary research had identified as constituting 92% of the higher education choices of locally-college-bound students. An additional college designated as the "ideal" was incorporated into the students' choice set in order to operationalize the ideal point preference model. Students also evaluated the colleges on a set of 18 characteristics that influence college choice. Factor analysis was used to reduce the 18 variables to a subset of four factors identified as: academic standards and reputation, religious emphasis and paternalism, social opportunity, and expensive and inconvenient. An ALSCAL multidimensional scaling algorithm was applied to the data and the output was a spatial representation of the colleges that reflects the competitive images students hold of these colleges and their relationship to an ideal. Results of the analyses are discussed. (SW)

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A STUDY OF STUDENTS' COGNITIVE STRUCTURE FOR COLLEGES

by

Steven S. Kuntz, Ph.D.
St. John's University
300 Howard Avenue
Staten Island, N. Y. 10301
(718) 390-4545 ext. 4506

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A Study of Students' Cognitive Structure for Colleges

Steven S. Kuntz
St. John's University
300 Howard Avenue
Staten Island, NY 10301
Tel.(718) 390-4545ex4506

Introduction

How a college is perceived in relation to its competition and to some conception of an ideal school can be valuable information to those responsible for marketing an institution of higher education. This paper is an attempt to build upon recent findings on the utility of an ideal point model in predicting college preference (Kuntz, 1987), and to demonstrate a methodology that operationalizes this model to reveal how students compare and evaluate the schools they choose among.

Conceptual Foundations

Several theoretical frameworks have been offered to explain preference formation in the academic environment, with one, the ideal point preference model, shown to outperform other constructs in situations concerning student decision making (Dubois, 1975). According to this construct, a set of alternative choice objects can be represented as points in multidimensional space reflecting consumers' cognitive structure for these objects. In the same space there exists an ideal object such that consumer preference ordering for the alternatives is simply the inverse of the ordering of the distances of each object from the ideal. Hense, the closer that object resembles the ideal, the more it will be preferred (Coombs, 1964).

When the objects of interest are colleges, then the images of these colleges and the criteria for positioning them in multidimensional space take on considerable meaning. Specifically, a perceptual map of students' cognitive structure for colleges in a competitive environment can provide a vehical for assessing the preferential attractiveness of a particular institution and may serve as the starting point for serious marketing efforts to influence that attractiveness.

The purpose of this paper is to provide some insight into how students structure the colleges they choose among in a particular educational market. In presenting this material, the hope is that the analytic tools displayed will encourage other institutions to follow this initiative and assess their place in the market with an eye towards influencing the future.

The Study Sample

The research sample consisted of 408 locally-college-bound high school seniors in classes drawn at random from 16 area schools. The study was conducted in January and February of 1985. This represented a time when seniors were assumed to be knowledgeable about colleges, having begun the testing and application processes, yet minimally biased towards particular institutions having, for the most part, not received acceptances or rejections.

Method

The data for the study was collected through the researcher designed College Image Questionnaire (CIQ). Reliability and validity of the instrument was established through pilot testing and other analyses prior to its use.

Administration of the instrument was conducted by the college counselors in the participating high schools during regular class periods. Of the 1,028 questionnaires that were distributed, 986 were completed for a response rate of 95.9%, with 408 falling within the criteria for analysis.

The questionnaire consisted of two parts. The first part asked subjects to judge directly the similarity (psychological distance) between nine pairs of colleges that preliminary research had identified as constituting 92% of the higher education choices of locally-college-bound youngsters. An additional college designated as the "ideal" was incorporated into the students' choice set for analytic purposes.

An ALSCAL multidimensional scaling (MDS) algorithm was applied to this data. The ouput of this analysis was a spatial representation of the colleges which reflects the competitive images students hold of these institutions and their relationship to an ideal. Inclusion of

the ideal college amongst the students' collegiate choice set has been shown to operationalize the ideal point preference model (Kuntz, 1987).

A second part of the questionnnaire required the respondents to evaluate the colleges on a set of 18 prespecified characteristics thought relevant in academic decision making. The 18 attributes were determined after an examination of the literature on college selection criteria and a pilot test performed on a distinct sample of 30 students. Factor analysis was used to reduce the 18 variables to a meaningful subset of four factors identified as "Academic Standards and Reputation," "Religious Emphasis and Paternalism," "Social Opportunity," and "Expensive and Inconvenient." Computed factor scores when combined with the stimulus coordinates from the MDS configuration were used to aid in the interpretation of the dimensions of the scaling solution. (See Table 1, Appendix A)

Results

Dimensionality

An MDS analyses was run for the sample population yielding perceptual maps in two, three, four, and five dimensions. Before an interpretation of the students' cognitive structure for colleges could be attempted, a determination of the appropriate dimensionality for the sample needed to be ascertained. Dimensionality refers to the number of coordinate axes used to locate a point in multidimensional space. Identifying the relevant dimensions on a perceptual map is tantamount to discovering the underlying characteristics that differentiate the stimuli on a given dimension. That is, the perceptual criteria by which the students evaluated the nine colleges plus an ideal school.

ALSCAL computes two measures of goodness-of-fit, stress and squared correlation. Each indicates how well the MDS solution captures the information transformed from the original proximity data. As the fit of the model to the data improves, one generally sees a decrease in stress and an increase in variance accounted for. The magnitude of change is useful in determining dimensionality.

As seen in Table 2, the addition of a third dimension produces a substantial decrease in stress and concurrent increase in squared correlation.

Table 2

Stress and Variance Accounted for
by Solutions of Different Dimensionality

Group	Statistic	Number of Dimensions 2	3	4	5
Total (n=408)	Stress	.288	.197	.153	.117
	Sq. Corr.	.482	.499	.504	.500

Although stress continues to improve with the addition of a fourth dimension, there is virtually no improvement in proportion of variance accounted for, the most important index for evaluating fit according to Young and Lewyckyj (1979).

While goodness-of-fit measures serve as a guide to determining dimensionality, this criterion is used in conjunction with a concern for stability, interpretability and ease of use. An assessment of the stability of the three dimensional solution was undertaken through a random splitting of the original data subject to separate MDS analyses. A comparison of the resultant configurations showed the three dimensions to be replicable across dimensions for each sample.

With respect to interpretability and ease of use criteria, interpretation is clear with three dimensions with little to be gained by going beyond this threshhold. The inclusion of a fourth dimension not only did not provide any substantive improvement in the fit, but resulted in fragmentation, rendering a solution of reduced comprehensibility. Thus, it would appear that three dimensions are sufficient to account for the judgment data in the sample population.

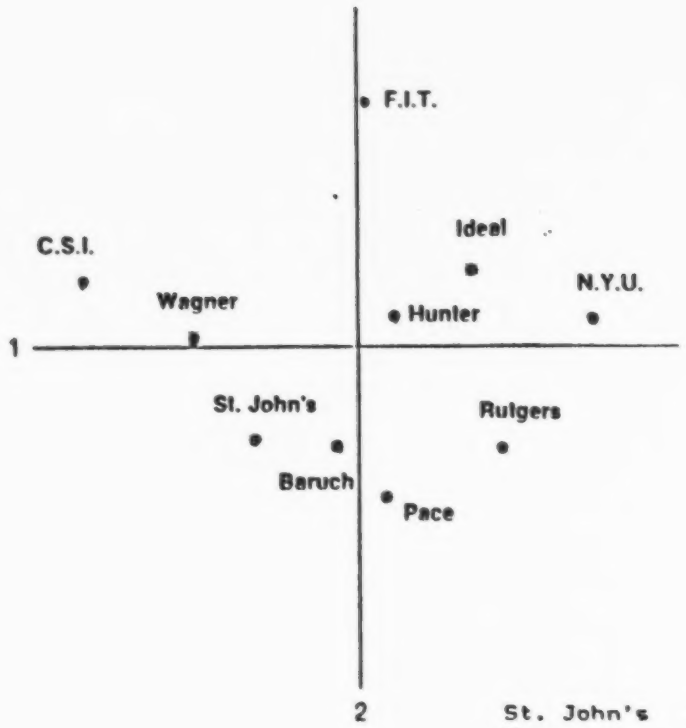
Students' Stimulus Space

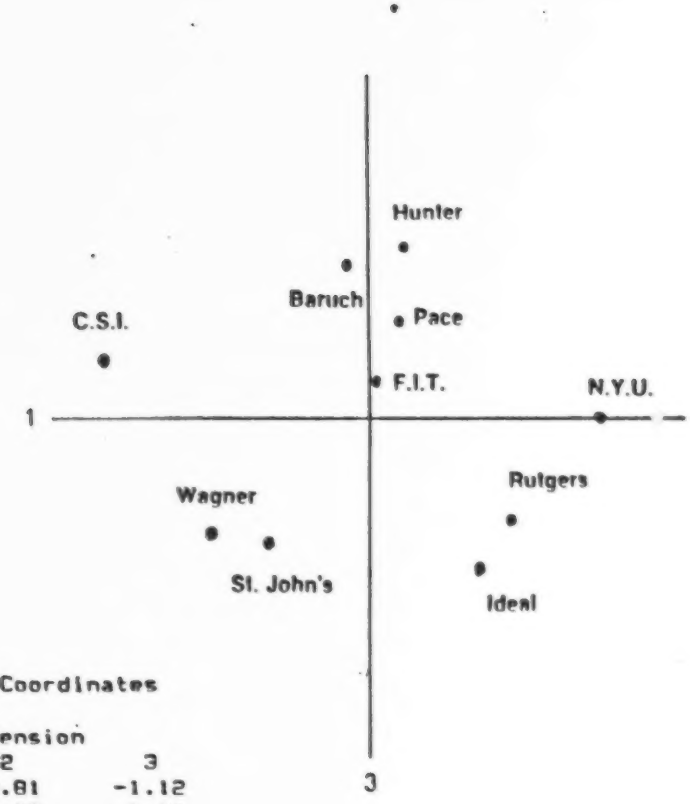
A single matrix for each subject's similarity judgments (n=408) was entered into an ALSCAL analysis. The three dimensional spatial configuration of colleges is depicted in Figure 1, with corresponding coordinate projections of each college stimulus on the dimensions listed within the figure. The stimulus coordinates are normalized to have a mean equal to zero and a standard deviation of 1.00. Rotation of the axes for the purposes of interpretation is unnecessary since the dimensions obtained from an ALSCAL analysis are uniquely oriented and are generally directly interpretable. No correlations among the three dimensions of this space are significant ($p>.05$), ranging from -.03 to -.07.

An initial attempt at naming each dimension was made by comparing colleges that loaded "high" and "low" on a particular dimension. Specifically, colleges with stimulus weights equal or greater than one standard deviation from the origin were used to designate polar opposites on each dimension (See Figure 1). When compared against each other vis-a-vis known characteristics about the colleges, a dimensional interpretation could be made.

Such a determination, when based upon the researcher's judgment, is essentially subjective. Yet, it can be said that the researcher was thoroughly familiar with the stimuli under investigation and was aided by the collective judgment of a panel of experts composed of nine college counselors from the high schools participating in the study. In addition, an empirical validation of this interpretation, through the use of linear regression analysis using external ratings of the stimuli, follows the initial labeling of the dimensions.

Identifying Dimension I on Figure 1 was relatively direct. Colleges which emerged on the positive end of the first dimension, N.Y.U. and Rutgers, are major universities which are among the most academically reputable and prestigious of the schools included in the study. Indeed, of the nine institutions analyzed, these two are the only colleges ranked in the The Gourman Report (1983) among the 50 quality post-





Stimulus Coordinates

	Dimension 1	2	3
St. John's	-0.74	-0.81	-1.12
Wagner	-1.16	-0.08	-1.01
N.Y.U.	1.64	0.22	-0.03
Baruch	-0.14	-0.95	1.35
Hunter	0.24	0.23	1.47
F.I.T.	0.07	2.19	0.29
Pace	0.19	-1.33	0.84
C.S.I.	-1.90	0.62	0.50
Rutgers	1.00	-0.96	-0.94
Ideal	0.82	0.71	-1.34

Figure 1. Stimulus Configurations for the Combined Group Derived in 3 Dimensions.

secondary institutions in America. Located at the negative pole on Dimension I are Wagner and The College of Staten Island, two schools with a reputation for liberal admissions policies and limited recognition for high academic quality (Consensus of Staten Island counselors, personal interviews, June, 1985). The former is a small private institution which has been near bankruptcy in recent years (Guarino, 1980), while the latter is a former community college with the only open admissions policy among the institutions studied (Kaye, Hunter, & Suber, 1985). This is not to say that the education offered at Wagner or The College of Staten Island is in any way inferior to Rutgers or New York University, for, indeed, all that is being compared are the images of these institutions and not necessarily their realities. In any case, as the first dimension would appear to provide a separation between academically prestigious quality universities and those that are not perceived as such, it was decided to name Dimension I "Academic Prestige."

Conceivably, an alternative interpretation would be to label Dimension I on either a "cost" or "convenience" continuum, as these variables would appear to vary directly and indirectly with the reputation of the polar opposites. A closer examination of the rank ordering of the colleges on this dimension, however, does not consistently concur with such an interpretation, as it would put one in the untenable position of suggesting that Baruch and F.I.T. are closer to Staten Island than Pace or that Rutgers is more expensive than Pace. Thus, it is concluded that the label "Academic Prestige" best captures the essence of this dimension.

Dimension II in Figure 1 is somewhat unique for it can be seen that F.I.T., the only technical institute, projects very highly on the positive pole, while several colleges and universities known for their business programs (Pace, Baruch, Rutgers, & S.J.U.) appear to cluster on the negative pole. Of the remaining colleges, which appear to cluster on the positive pole near zero, it could be said that each is distinguished by its non business orientation or in two cases (C.S.I. & Hunter) by certain technical programs. On the basis of the separation of the technical school from a number of colleges distinguished by their business programs, it was felt that this dimension reflected two types of schools or programs. To be specific, it was decided to

identify Dimension II as "Technical versus Business Orientation."

With the presence of F.I.T. among the stimulus set, an institution perceived as very different fr[illegible] the others (over 2 standard deviations from the origin), it could be argued that its presence unduly influenced the final ALSCAL spatial configuration and its dimensionality. Hence, one might be concerned that this dimension should more properly be labeled "F.I.T.". Such an interpretation would, however, be tantamount to questioning the stability and generalizability of this dimension. In order to put this notion to rest, a complete reanalysis of the data based on the other nine colleges produced a three dimensional solution which was quite similar to the original solution. A Pearson product-moment correlation between the interpoint distances of the original total group configuration with F.I.T. ignored, and the newly obtained nine college configuration was calculated revealing an $r = 0.94$ for Dimension II. It did not appear, therefore, that the spatial representation derived in this study was affected by the inclusion of a unique school. Thus, the labeling of Dimension II as "Technical versus Business Orientation" appears justifiable.

In Figure 1, Dimension III appears to consist of two distinct clusters of colleges. Those aligned on the negative pole (S.J.U., Wagner, & Rutgers) are generally considered to be somewhat the "fun" schools when compared to those on the positive pole (Baruch & Hunter) which share a more serious reputation. Indeed, if the number of social organizations on campus could be used as an indicator of the social atmosphere of an institution, then the three negatively aligned schools can be said to have over three times as many fraternities and sororities as the six other institutions combined (Kaye, et al., 1985). Although the percentage of students belonging to organizations would probably provide a more compelling justification for concluding that Dimension III was a "Social Opportunity" dimension, it was nevertheless felt that there was sufficient cause to draw such a conclusion. Hence Dimension III was labeled "Social Opportunity."

External Analysis. The factor scores obtained independently of (externally to) the scaling analysis were used to validate and expand upon the visual interpretation of the MDS configurations (Coxon, 1982).

When used in conjunction with the college coordinate weights from the configurations (See Figure 1), the factor scores provide an empirical means of interpreting the dimensions. That is, the relationship between the subjects' college similarity scores and their rating of the colleges on the eighteen attributes, collapsed into four factors, is determined. In effect, the attribute data is fitted onto the scaling solution.

To accomplish this, the ratings of the stimuli on each factor were entered into a linear multiple regression with each factor serving in turn as the dependent variable, and the college coordinates on the three dimensions as the independent variables. The analysis yields a statistical measure of the relationship between the external rating scale and the spatial configuration (i.e., multiple correlation), as well as weights indicating the degree of collinearity between the scale and a given dimension (Lawrence, 1985).

The results of this analysis are presented in Table 3. The ability of the ALSCAL dimensions linearly to predict the factor scores is indicated by the multiple correlations. Three of the factor scales, "Academic Standards and Reputation," "Social Opportunity," and "Expensive and Inconvenient," are statistically significant ($p<.01$) and meet the .90 criteria for multiple correlations. This stringent

Table 3

Normalized Regression Weights (Direction Cosines) and Multiple Correlations Between Factor Scales and ALSCAL Dimensions For The Combined Group Solution

	Normalized Regression Weights (Direction Cosines)			
Factor Scale	Dim. I	Dim. II	Dim III	Multiple Correlation
1. Aca. Stds. & Reputation	0.839	-0.354	-0.413	0.965**
2. Rel. Emph. & Paternalism	0.063	-0.455	-0.888	0.860
3. Social Opportunity	0.307	-0.441	-0.844	0.957**
4. Expensive & Inconvenient	0.997	0.028	0.074	0.930**

** Significant at the .01 level. $p<.01$

criterion was necessitated by the inflated multiple correlations anticipated when a limited number of cases (equal to the number of stimuli) are used in the regression. The fact that so many of the multiple correlations are high suggests that when linearly combined these three dimensions tap the relevant factors in the perception of colleges.

The first three numerical columns in Table 3 show the relative importance of each dimension in predicting the factors. These are the regression coefficients normalized so that the sum of the squares equals 1.00 for every scale (Kruskal & Wish, 1978). The regression weights can also be viewed as direction cosines, in that each scale represents a vector in the stimulus space such that the angle each makes with an axis of the configuration can be used to interpret the dimensions. The narrower the angle, the stronger the relationship between the factor and the dimension.

It can be seen that the first ALSCAL dimension is strongly associated with two factors, "Expensive and Inconvenient," and "Academic Standards and Reputation. The fourth scale has a high multiple correlation (.935) and a direction cosine (.977) that almost coincides with the dimension. (A regression weight of 0.977 corresponds to an angle of 4 degrees since cosine 4 = .997). The first scale also has a substantial multiple correlation (.965) and relatively high weight (.839) on the first dimension. It would appear that both factors are complementary in that one would anticipate that the institutions regarded as higher in quality would also be costlier and less accessible. Such findings can be seen to support the researcher's earlier visual interpretation of Dimension I as being an "Academic Prestige" dimension.

On the basis of the multiple correlations and regression weights it would appear that none of the four

factors are associated with Dimension II. This is consistent with the previous labeling of the dimension as "Technical versus Business Orientation" in that none of the factors appear to tap this dimension.

Since there is always the danger in external analsis that the attributes selected by the researcher for rating may not include the relevant perceptual criteria used by the population, the emergence of a latent dimension through the MDS analyses demonstrates the value of this procedure, and indeed provides ample justification for applying a two pronged approach in this inquiry. Thus, although the regression analysis does not support the intuitive interpretation of Dimension II, neither does it refute the researcher's own judgment. As a result, it was decided to retain the original interpretation of this dimension as "Technical versus Business Orientation."

Dimension III was previously identified as a "Social Opportunity" dimension. The observation of a high multiple correlation (.957) and large direction cosine (-.844) between the third dimension and the "Social Opportunities" scale sustains this interpretation. It should be noted that the negative signs in this and subsequent regression analyses in this study represent an artifact of the scaling analysis and can be ignored.

To summarize, as a result of the researcher's panel supported interpretation of the MDS configurations, aided by the regression analysis, the three dimensions for the combined solution were identified as: Dimension I, "Academic Prestige,"; Dimension II, "Technical versus Business Orientation"; and Dimension III, "Social Opportunity."

Limitations

As with most research of this kind, the interpretation of the results must be approached with some degree of caution. Results obtained from a sample of students in a single market involving their perceptions and evaluations of institutions specific to that environment cannot be generalized to all students or to all environments.

Implications

The assessment of a college's image is generally regarded as the starting point for any serious marketing effort (Kotler, 1975) in that it generates the requisite information for developing and promoting those aspects of an institution that most appeal to propective clientele.

Figure 1, for example, has revealed the perceptual positions of institutions in a particular educational market. Hypothetically, a school could be projected onto that configuration as the closest among colleges to the "Social Opportunity" ideal, but the furthest removed from the ideal in "Academic Prestige." Armed with such information, administrators at this institution could attempt to emphasize social factors in its promotional efforts. Alternatively or concurrently, the college could make an effort to shift its image closer to the "Academic Prestige" ideal, though such an undertaking might very well require substantial adjustments in that school's mission, admission's criteria, standards, programs, faculty, or a host of other variables.

Any effort to shift or project a college's image close to the students' ideal constitutes an attempt to capitalize on a understanding of the preference formation process. With student preference formation explainable to a certain extent through a spatial distance construct, the ideal point preference model, a justification exists for applying the MDS methodology to the educational marketplace. Through the utilization of such an approach, the management of student preferences is well within the realm of institutional potentiality, though for such an undertaking to reach fruition would probably require considerable institutional self-examination and possible redefinition.

Conclusions

The results of this study clearly demonstrate that multidimensional scaling can be used to identify the characteristics students would most like to see in a college as well as the images of colleges as they exist in the educational marketplace. With student preference formation explainable to a certain extent on the basis of distance from an ideal, a justification exists for extending the MDS methodology to examine

students' cognitive structure for colleges in other marketplaces. With little modification, this approach could be used by other colleges and universities to assess their place in the educational market, develop stategies, and enhance their competitive position in academe today. Ultimately, as institutions of higher education reflect upon their own institutional reality, the end result may be the opportunity to manage and shape their own destinies.

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APPENDIX A

Table 1

Factor Scores Generated from Promax Rotated Solution

College	Factor I (Aca.Std. & Rep.)	(rk)	Factor II (Rel.Emph. & Pater l.)	(rk)	Factor III (Social Opp.)	(rk)	Factor IV (Expensv. & Inconv)	(rk)
St. John's Univ	0.250709	(3)	0.608763	(1)	0.490398	(1)	-0.439888	(8)
Wagner College	-0.144550	(6)	0.107523	(3)	0.153743	(4)	-0.225157	(7)
New York Univ.	0.608207	(1)	0.081248	(4)	0.188586	(3)	0.476501	(1)
Baruch College	-0.174866	(7)	-0.201063	(7)	-0.213082	(7)	0.095631	(6)
Hunter College	-0.075576	(5)	-0.122482	(5)	-0.180838	(6)	0.197654	(5)
Fashion Inst	-0.283328	(8)	-0.294968	(8)	-0.372056	(9)	0.250660	(3)
Pace College	0.192565	(4)	-0.129112	(6)	-0.137447	(5)	0.224188	(4)
College of S.I.	-0.729526	(9)	-0.234984	(8)	-0.351847	(8)	-0.988981	(9)
Rutgers Univ	0.415383	(2)	0.181482	(2)	0.441600	(2)	0.433854	(2)

Note. The rank ordering of the Colleges on each of the factors is in parentheses.